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Wi-LAN, Cisco clash over broadband turf: Calgary-based company in thick

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HEADLINE: Wi-LAN, Cisco clash over broadband turf: Calgary-based company in thick of race for piece of wireless broadband market; Company Business and Marketing**BYLINE:** Solomon, Howard**BODY:**

The future of broadband wireless service is getting clearer after a week of hectic news and speculation.

"We're at the knee of an adoption curve that is flexing up as new technologies are enabling higher bandwidth to be handled by wireless through the local loop," said Bill Hews, president of Wi-LAN Inc. of Calgary, which makes high-speed wireless bridges.

Wi-LAN and partner Phillips Semiconductor hosted a meeting in California last week that drew dozens of companies to discuss ways to speed up wireless deployment by carriers and within the enterprise.

Broadband wireless products are needed by providers to deliver high-speed voice, data or video service across gaps in their fibre networks, and by companies who need local area network broadband service within or connecting to their buildings.

"Everybody's realizing it's time to roll this capability out," said Hews.

That expectation made Wi-LAN stock soar briefly amid rumours that Cisco Systems Inc., which was invited to the meeting, would make a play for the company and its technology. Instead, Cisco said a wireless suite announced in November would be available for sale this month. The WT2700, a wide area network (WAN) system for its universal broadband routers is said to be capable of transmitting up to 40 megabits per second (Mbps) in the low frequency spectrum suited for small and medium-sized business needs. Cisco's technology in part comes from its purchase in September of Clarity Wireless Corp.

In June Wi-LAN announced its upcoming i.WiLL 3-24 Access Point for telcos and ISPs will be capable of up to 30 Mbps. It's in field trials now, and Hews expects certification in Canada and the U.S. to be completed early next year. He believes 12 months from now Wi-LAN will be demonstrating products delivering up to 90 Mbps.

Both products can operate in unlicensed sections of the broadcast spectrum, a key consideration for buyers looking to install technology quickly.

Both companies say they use improved versions of orthogonal frequency division multiplexing (OFDM) that solve multipath problems associated with conventional OFDM. Broadband wireless transmitters usually need to be within line of sight of receivers for best performance.

However, Greg Rawleigh, Cisco's director of wireless engineering, said its product is "quite different" from Wi-LAN's, claiming it can transmit as much as six miles point to point around obstructions such as buildings.

Wi-LAN, Cisco clash over broadband turf: Calgary-based company in thick

Wi-LAN officials were at their conference and couldn't be reached for comment. However, in an earlier interview Hews said line-of-sight problems could be met by the way the network is engineered.

The demand for high bandwidth services for areas outside city cores without fibre optic lines is driving interest in wireless, said Iain Grant, managing director of the Canadian division of the Yankee Group. "Everybody's looking for an answer," he said, "so the world is beating a path to the radio door."

Wi-LAN has demonstrated it can transmit 30 Mbps in an unlicensed band, he said, and that's music to the ears of almost every upstart competitive local exchange carrier (CLEC) offering local phone service. Even established phone companies will buy wireless because they haven't got fibre lines everywhere.

The market potential is huge, say industry analysts. Wireless local area network users alone in the U.S. are expected to increase tenfold over the next five years, growing from 2.3 million this year to 23 million in 2003, reports Cahners In-Stat Group of Newton, Mass.

"New low-end, more cost effective products are attracting smaller customers for their first networks," said Kneko Burney, a Cahners director, "and in larger firms, a growing number of remote/branch offices needing networks are considering wireless alternatives because they are portable,"

"Out of the office, new supply chain technologies are connecting increasing numbers of non-administrative workers to corporate resources via wireless supply chain devices. All these forces combine in what we expect to be phenomenal growth in the market."

For Hews, who came to Wi-LAN just four months ago from Nortel, the sudden attention the company's getting is exciting.

Wi-LAN has been selling its Hopper and Hopper Plus wireless modems and bridges since 1996 to extend local networks. The i.WiLL access point is its fastest product and will cost US\$ 15,000 per unit, with at least two needed for transmitting and receiving. Lower cost units for LANs will be delivered in the near future, said the company.

The company sees three markets, Hews said: WANs, LANs and the home set-top multimedia market. Its partnership with Philips is being used to tap the latter sector.

"As telcos look at reaching people with higher speeds being demanded for Internet access, wireless is a complimentary solution to options such as fibre, DSL and cable," he said.

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HEADLINE: STRATEGY; TECHNOLOGY ADOPTION; CAN YOU FIND IN A PRODUCT A GORILLA JUNGLE?

BODY:

Geoffrey Moore is one of the IT industry's most respected thinkers. In this exclusive extract from his best-selling book *The Gorilla Game*, he shows how people respond differently to new technology.

The massive success of companies with seemingly mediocre technology, such as Microsoft, is often written off as the fruit of clever marketing.

But it's not all about marketing - technology revolutions occur as much through users' behavioural changes as through the sales strategies of vendors.

In this edited extract from his latest book *The Gorilla Game*, celebrated technology writer Geoffrey Moore explores the key to spotting 'gorillas' - the Ciscos and Microsofts of the future - not by tracking their marketing spend, but by recognising the characteristic ways that organisations and IT buyers respond to innovation.

Discontinuous innovations

Who wants a car with no highways; a VCR without movies to rent; a microwave with no microwaveable meals or recipes; a game machine with no games to play?

While most technological innovations are continuous, building upon the standards and infrastructure already in place, from time to time technology breakthroughs enable an entirely different kind of offering - a discontinuous innovation.

The first semiconductor, the first PC, the first spreadsheet, the first local-area network, the first fax, the first relational database, the first Web browser - and, for that matter, the first automobile, the first television, the first microwave dinner - all these products introduced completely novel benefits that were extremely compelling.

To enjoy these benefits, however, customers had to adopt new technologies and put in place new infrastructures that were incompatible with what was prevalent at the time.

Not only did they have to go through a whole learning curve on their own, they also had to wait for all the providers of complementary products and services to get their part of the system up and running.

In other words, offers based on discontinuous innovations have a built-in delayed gratification principle. This generates a range of reactions, modelled by the technology adoption life cycle.

The adoption life cycle

For high-tech markets, five response profiles have proved remarkably consistent over the years. Each is based on a defining attitude toward discontinuity.

This model is the foundation for understanding high-tech market development.

It is based on work done by Everett Rogers and his colleagues at Harvard University in the late 1950s. It is still the basis for 'diffusion of innovation' research and continues to provide insights to high-tech managers every year.

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The model predicts that whenever a market is exposed to a discontinuous innovation, users will self-segregate into five different response profiles.

Taken all together, these profiles represent the five basic strategies for responding to the opportunity created by a discontinuous innovation.

Any one individual might make any of the five responses, depending on how he or she sees the new technology. That is, real people tend to be early adopters in one area and late adopters in another.

Enthusiasts

In Fortune 500 companies, you'll find these people working in the advanced technology departments. They are charged with the responsibility of keeping their company abreast of the new technologies and believe in the inherent value of technology. They are willing to experiment with discontinuous innovations simply to explore their properties in the expectation of finding something of value.

The group also includes legions of hackers and independent developers who are pushing the edges of what's possible on the Internet and elsewhere.

In consumer markets these are the gadget lovers who snap up the latest palmtop organiser or multifunctional peripheral, only to put it down a few months later for some newer, neater toy.

Winning the endorsement of this group is an important step for any new technology in gaining initial market visibility and credibility, as the enthusiasts hold a lot of sway among customers in the early market.

However, they are not representative of the marketplace at large and are not a good predictor of whether a mainstream market will ever develop - their closets are probably full of laser disc players, eight-track stereo tapes and Apple Newtons.

Visionaries

Highly-placed executives looking to leapfrog the rest of their industry sit in this category. They examine discontinuous innovations for opportunities to radically re-engineer their company's business processes in ways that might totally pre-empt a competitive response.

When they find one that appeals to them, they champion it in a big way, be it American Airlines' Sabre reservations system, Federal Express' use of package tracking systems, or Amazon.com's trailblazing use of the web for book-selling. Their goal is to set themselves apart from the herd - by herd, they mean the pragmatic majority of people who do not adopt discontinuous innovations until they see other people doing so.

Visionaries love doing things that the herd would never do, because if they are successful, they will gain a huge headstart over the rest of their competitors.

Visionaries are incredibly valuable in helping new technologies gain early visibility, particularly via the business press, where they are often celebrated for their forward-thinking approaches to challenging business problems.

Like technology enthusiasts, however, their endorsements are not a good predictor of whether a mainstream market will ever actually develop.

It often happens that by the time a technology they have sponsored is mature enough to be adopted by the masses, some other new technology has come along that creates enough uncertainty to stall the market again.

This is what happened to massively parallel computers, object-oriented databases, and artificial intelligence.

Pragmatists

These represent the herd. They see new technology as valuable, but only after standards have been set and systems have been thoroughly shaken out. Their strategy is to adopt the new paradigm if, and only if, everybody else does. This is a strategy of conforming to the herd, and it is the fundamental mass-market behaviour. This leads to 'go as a group' response that has the same effect on market development that block voting has on elections.

When the herd does decide to go, it goes all at once, which creates a dramatic spike in growth, or hypergrowth, called the tornado.

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Conservatives

Conservatives are much happier staying with the systems they have than switching to anything new - regardless of how much better it is supposed to be. Ultimately, when they do buy in, they act as latter-day followers of the pragmatist herd, buying what it bought, only later.

Buying late in the life cycle gives them the opportunity to exploit mature competition to negotiate better prices and values.

Sceptics

These would-be IT customers simply never buy from anyone. They see technology investments as overpriced and overpromised, and prefer to spend their money instead on low-cost, non-technical solutions.

These non-buyers are most significant for their ability to block adoption movements as they reinforce the inertia that high-tech market development strategies must overcome.

The early market

The way high-tech markets typically develop is shown in the chart over the page (page 40).

Reading from left to right, the first commercial activity around a discontinuous innovation is sponsored by visionaries and supported by technology enthusiasts.

Together they seek to use the new technology to enable some radical change that will give them a dramatic competitive advantage over other companies in their category.

The most dramatic example of an early-market technology is electronic commerce over the Internet. Forward-thinking businesses in virtually every sector are seeking out competitive advantage via the web to re-engineer traditional business transactions.

There is a constant stream of articles about Dell Computer, Cisco Systems, Amazon.com and Federal Express, with each acting as a visionary in its own sector. As yet, however, there is no mainstream market for business systems on the web, as pragmatists still wait and watch.

A key characteristic of the early market is that it is based on large deals championed by highly placed executives in the companies buying the new technology. The sponsor needs to be highly placed, both to have the clout to drive through to completion a high-risk re-engineering initiative and to have the budget resources to pay for the high cost of systems integration and consulting needed to deploy any system this early in the life cycle.

When reading case histories of these deals, expect to hear of bold business actions, of management teams going ahead of the herd. These are early-market signals, rather than the tornado.

Another key characteristic of this phase is that it is built around individual customers, not market segments. Visionaries do not want to co-operate in helping other companies in their competitive space get current on the new technology. They intend this new technology to be their differentiating advantage, so resist other sales into their sector.

They will co-operate, on the other hand, with companies outside their competitive space. As a result, the customer list for an early-market company typically features a number of high-profile companies, but frequently there are no two from the same market segment.

The early market is extremely attractive for top-tier service companies like EDS, Andersen Consulting, and Cambridge Technology Partners, which specialise in business process re-engineering and systems integration.

Companies that want to be first to implement new technologies know they need a host of high-margin services from institutions with depth, breadth and staying power. This creates huge demand for professional services firms, and it is they who garner the lion's share of profits in the early market.

By contrast, in a tornado market, product vendors dominate by minimising the service content in an offering in order to proliferate it more rapidly, more broadly and at lower cost.

For the company introducing the discontinuous innovation, the early market is a gestation phase and a chance to prove the feasibility of its technology in a few highly-customised projects. It is not a source of significant revenue or

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profit generation, and as soon as the proof-of-concept goal has been met, it behoves these companies to exit the early market and move on to the mainstream market. But ... between these two markets looms the chasm.

The chasm

The chasm is a hiatus in market development during which there is no natural customer for the discontinuous innovation. It is a consequence of the polar opposition between the visionary, who is deliberately going ahead of the herd, and the pragmatist, who is just as intent on staying with the herd. Each strategy wants to keep its distance from the other - hence the chasm between them. Here's how the dynamics play out.

As more and more customers adopt the innovative technology, the time gap between adopting now and adopting with everyone else begins to shrink.

Visionaries begin to doubt they will have adequate time to pre-empt a genuine competitive advantage ahead of the herd. They fear, in other words, that some fast follower could catch up with them and weaken their first-mover advantage. At this point in the adoption life cycle, visionaries start losing interest.

At the same time, pragmatists are far from ready to take up the mantle of technology adoption. They are still waiting to see if their fellow pragmatists are adopting, and if so, whether they are having any success.

Specifically, they are looking for references within their own community who can testify to surviving the plunge.

At this point, however, there are no such references - only the odd visionary whose project is too radical to be representative of what a pragmatic person wants to undertake. So the pragmatists bide their time, perhaps by running a small pilot project, but most likely by attending seminars to keep abreast of events.

Meanwhile, as the pragmatic customers sit on the fence, competitors of the vendor do not. The new technology's success in the early market has attracted the attention of the established vendors, which have a vested interest in maintaining the status quo. They now unite to expel the intruder, sowing seeds of doubt about the new company's financial viability and ridiculing the immaturity of its product and the incompleteness of its integration. If the innovator cannot secure a market position for itself relatively quickly, it will die in the chasm.

This was the fate of expert systems, desktop videoconferencing, pen-based computing, computer-aided software engineering tools, and neural networks.

No longer novel enough for the visionaries to find ongoing competitive advantage potential in them, they remained discontinuous enough to keep the pragmatists at bay. In most cases, the products lingered on for a while, each year generating more costs than revenues, until finally the companies that sponsored them either dissolved or moved on to other things.

Needless to say, all the money invested was lost.

The bowling alley

On the safe side of the chasm and at the frontier of the mainstream market is the penetration phase of the technology adoption life cycle - the bowling alley. This represents niches of pragmatists who are willing to adopt a new technology ahead of the herd.

But why do these niches exist considering that pragmatists are, by definition, herd animals? They exist in subsets of pragmatists which, united by a common cause, aggregate into micro-herds that move ahead of the main herd.

Bowling alley market segments typically build up around departmental functions where managers find themselves saddled with what we call a broken, mission-critical business process. These broken processes are jeopardising the entire enterprise's ability to serve its customers.

Top management has put these managers on notice to fix the process, or else. The sense of urgency is great - these are pragmatists who fear they may be about to get fired. As such, they seek out their opposite numbers in similar companies to find out if they have seen the problem, and if so, if they have found a solution. What they discover is that, yes, the problem is rampant, and no, nobody has a solution yet.

This was the situation in the early 1990s, for example, when customer support managers in high-tech firms were overwhelmed with the number of 0800-number technical support calls they were receiving and as a result customers were often put on hold for up to 45 minutes.

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The existing systems simply could not handle their unusual peak-period demands, partly because it took so long to answer customers' questions.

Chief executives would get angry complaints and call the support group onto the carpet. When the support managers talked to their opposite numbers, they found out the whole industry was at fault. It seemed that the complexity of the new systems was so great that no one could manage the load. An entire segment went in search of a solution to a common problem and ended up sponsoring a whole new category of software. That was how the customer support software market crossed the chasm and got its first start in the mainstream market.

Examples of other niche markets that have allowed discontinuous technologies to cross the chasm include:

Graphic artists for the Macintosh - the old methods could not respond to the number of changes and the need for fast turnaround

Hollywood film editors for Silicon Graphics digital graphics workstations - it was costing Hollywood tens of millions of dollars to edit and re-shoot parts of their films, resulting in huge budget overruns

Wall Street traders for Sun workstations and Sybase databases - traders are always under pressure to find faster and more market-responsive trading systems.

In each case, these segments were stuck with serious business problems that had to be solved immediately but could not be addressed effectively without embracing a discontinuous innovation.

Managers who are under this kind of 'broken-process' pressure will sponsor a new technology ahead of the herd, but only if the system provider can commit to an end-to-end solution to their problem. That is, to win over their target segments, each of these product vendors has to commit not just to providing an excellent product, but also to fielding a complete suite of products and services to solve the entire problem for the target segment.

This leads them to recruit other companies that have the necessary competencies they lack, thereby forging a whole new value chain where none had existed before.

Once such a team is formed and the market has rallied around its solution, all other vendors get summarily excluded from the segment as pragmatists like to standardise on a single solution once they find one that works.

So these first movers get to enjoy the fruits of market leadership for a long time to come.

It is this capability to support a new value chain's formation that makes the bowling alley phase so important. It is literally a new marketplace coming into being.

The reward for every company in this new marketplace's value chain is the opportunity to grow with virtually no competition from well-established vendors.

The bowling alley stage is the earliest at which a high-tech company can truly define itself as a going concern, because for the first time it has committed customers and a protected marketplace to support it in the years to come. This does not place them in the gorilla game yet, because there is not yet a mass-market phenomenon.

These companies can all look forward to growth, but not to hypergrowth.

The reason niche markets are called the 'bowling alley' is that market growth will be niche to niche, leveraged by the prior niche's solution set and reference base of customers. By this mechanism, companies can continue to grow their marketplace in advance of gaining widespread mass-market support. Each new niche creates a moment of 'micro-hypergrowth', as all the pragmatists in that niche follow the micro-herd to adopt the new technology. But it does not create 'macro-hypergrowth' - that is what happens when entire mass markets adopt the stuff from which true gorillas are made. For that to occur, the market must transition to the tornado.

But this transition is by no means a forgone conclusion: many markets stabilise in a state of 'bowling alley forever'. These markets never transform from niche to mass, but just continue along as a series of niches. This is the pattern that has characterised specialised niche companies such as MapInfo and ESRI in geographical information systems, Applied Materials and Lam Research in semiconductor equipment, and Autodesk and Parametric Technology in mechanical CAD software.

Such companies can continue to grow for only so long if they never enter into a true mass market. Sooner or later, they run out of new niches.

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After that they settle down onto Main Street, typically with good margins, good service revenues, but nothing like the market valuations of true gorillas.

The tornado

The tornado is a metaphor for the hypergrowth stage in technology markets caused when the buying resistance of the pragmatist herd finally caves in, and they rush to adopt the new technology en masse. This creates a massive updraft in demand, with every supply chain in the world rushing in to fill the void.

The tornado represents the proliferation phase of the life cycle, during which the new paradigm springs up everywhere seemingly at once. It is caused by the same herd dynamics that create the chasm, only now operating in reverse. That is, the same urge to conform that led pragmatists to hold back as a group now leads them to jump in as a group.

This action creates a mass market overnight - the entire herd in motion - thereby creating a severe inversion of supply and demand. This inversion, in turn, stimulates a tornado, or hypergrowth - not untypically 300% per year in the very early phase, 'slowing down' to 100% over a longer period - as every supplier in the category seeks to ramp capacity to take advantage of this demand.

The tornado is the force behind the exponential customer adoption S curves that get drawn over and over again by high-tech market analysts - the ones who track the proliferation of telephones and TVs, faxes and cell phones, email and voice mail, word processors and spreadsheets, relational databases and client/server applications. At present, Internet access for email and the web for browsing are both inside the tornado. Traffic is doubling every four months, as are HTML pages and web sites, and every major network provider has had dramatic outages as it scrambles to keep pace.

This scrambling will continue for as long as it takes the marketplace to catch up with the backlog of demand. Once that happens and supply again exceeds demand, the marketplace will convert to more stable but ongoing competition among established players within an established category - what we call Main Street. The hypergrowth era will be over.

The key to the tornado from an investor's point of view is the astonishing impact it can have on the relative market share of the vendors competing within it. Typically at the outset, there are a handful of plausible candidates for market leader, all bunched together, each having market share within shouting distance of each other.

Sooner or later, one of these vendors shoots out of the pack, rapidly distancing itself from the others, taking with it the lion's share of the future sales and an even greater percentage of the future profits of the sector, forever. This is the Microsoft, the Intel, the Cisco, the Oracle - which fit the gorilla role.

This is not simply a function of having better marketing, a better product or any other obvious cause, although all of the above can certainly help.

Instead, it is primarily a function of the market itself desperately needing to set technology standards to interface all this proliferation of new products into the existing infrastructure of systems. Unfortunately, because the market is just taking off there are no such standards, nor in the midst of hypergrowth is there time to deliberate upon them.

So the market makes do with de facto standards, basing these on the product architecture of the market-leading vendor.

This is a hugely significant outcome. Whichever vendor is fortunate enough to become the standard-setter in the new market is virtually guaranteed a role in any solution that a complementary partner proposes.

If one has the standard database, for example, then every hardware vendor wants it to run on their hardware, every software application vendor wants it to run under their application, and every organisation wants it because that way their systems are guaranteed to be compatible with future releases from these companies. The power that is thrust upon this vendor is awesome.

Once established, the gorilla position is virtually unassailable. Not only has the company itself become rich and powerful, but also all the other vested interests in the market have a motive to keep it in power, because the gorilla architecture is like a reef upon which this new ecosystem has sprung up.

Every living thing in the system has a stake in keeping it stable - including those that invest in or use the technology.

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Pragmatists adopting during the tornado have instinctively figured out this dynamic. What they used to say to each other was: 'Nobody ever got fired for buying IBM.' Nowadays they substitute other gorillas for IBM, but the philosophy is still the same.

The gorilla has the only lasting play and therefore is considered the only truly safe buy - compounding its phenomenal success.

INTRODUCING A HIGH-TECH VISIONARY

Geoffrey Moore is chairman and founder of The Chasm Group, a high-tech marketing consultancy that numbers Microsoft, HP, Oracle, IBM, Sun Microsystems, SAP and just about every other leading IT player among its clients. He is also a partner in California-based venture capital firm Mohr Davidow Ventures, where he provides advice to smaller high-tech companies just starting out. Moore's first book was the hugely influential *Crossing the Chasm*, published in 1991. The concepts it used for describing how technology markets develop have been widely adopted in IT companies and are now taught in top American business schools. *Crossing the Chasm* gave the emerging IT industry the vocabulary it needed to understand itself and plot its marketing strategies.

Moore's second book, *Inside the Tornado*, followed four years later, and set out to help firms make sense of the sudden periods of hypergrowth characteristic of high-tech markets. *The Gorilla Game*, from which this extract is taken, is Moore's most recent book, co-written with Chasm Group partner Tom Kippola and stock investment advisor Paul Johnson. This focuses on the development of high-tech markets from an investor's perspective.

Gorilla is the term Moore gives to a firm such as Microsoft or Cisco that ends up totally dominating its market.

This extract is adapted from *The Gorilla Game* by Geoffrey A Moore, Paul Johnson and Tom Kippola, ISBN 1-84112-001-4, and is reproduced by permission. The book costs GBP 19.99 and is published in the UK by Capstone, www.capstone.co.uk Computing readers can get this and Moore's earlier books *Crossing the Chasm* (normally GBP 12.99) and *Inside the Tornado* (normally GBP 9.99) at a 20% discount. Contact Capstone Publishing direct on (01865) 798623 and mention 'Computing offer'. Email: capstone_publishing@msn.com

More information about Geoffrey Moore's ideas are available at The Chasm Group site, www.chasmgroup.com.

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FINANCIAL SERVICE ONLINE

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LENGTH: 3227 words**HEADLINE:** Stock Trading Goes Wireless**BYLINE:** By Wesley R. Iversen**HIGHLIGHT:**

A growing number of vendors and online brokerages-including one of the industry's largest players-are rolling out wireless trading services using handheld devices.

BODY:

On the beach or the golf course, in a car, at a restaurant or while lounging in a hot tub... If proponents of an emerging new breed of wireless Internet trading technology are right, there soon will be almost no place where active investors won't be accessing the Web to buy and sell securities, while staying in constant touch with the market and their portfolios.

Consumers using laptop personal computers with wireless modems can already connect to Web-based brokerages for trading, of course. But the latest technology brings a similar capability to much smaller, handheld devices-including "smart" cellular telephones, personal organizers such as 3Com Corp.'s PalmPilot Professional, handheld Windows CE-based PCs and even two-way pagers.

The new services typically rely on tiny Web browsers built into the devices, along with data feeds stripped of normal Web site graphics to accommodate the smaller displays found on handhelds. Trade orders are transmitted using various standards that allow data to be sent over existing cellular voice networks. As part of the package, consumers can generally receive real-time quotes and automated alerts of market movements and breaking news events. Further, thanks to the flat-rate monthly pricing offered by many cellular network providers, investors can afford to keep their devices constantly connected for up-to-the-second market intelligence, proponents point out.

So far, only a couple of small online brokerages are offering the service. But others-including industry heavyweight Fidelity Investments-are planning soon to begin offering handheld wireless trading to their customers.

Some of the early reports from brokers are enthusiastic. "The response has been overwhelming," says George Bokios, president of Chicago-based Regal Discount Securities Inc., whose InvesTrade online trading subsidiary was one of the first to roll out wireless Internet trading for handheld devices in late September, using a system supplied by w-Trade Technologies, New York.

"Our clients to a large degree are active investors who always want to know what's going on with the market and have the ability to trade, especially in these volatile times," Bokios says. "So having a device like this is a moneymaker for them."

Skeptics

Others, however, are not yet convinced that wireless trading with handhelds is ready for mainstream application. Some industry executives point to gaps in cellular coverage areas that could inhibit investors' ability to trade and receive data

in some parts of the country, or in subways or certain office buildings, for example. Others wonder about the true utility provided by the pint-sized displays found on many handheld gizmos.

"We are definitely looking at this technology, but we're just not sure how many customers are really going to want to use it," says Vincent J. Phillips, vice president of Web systems for San Francisco-based Charles Schwab & Co. Inc., the industry's largest online brokerage. "With the Web products we offer today, the user interface is very rich, and it's not really represented well on things like PalmPilots and cellular phones," Phillips says.

Michael J. Anderson, president of Ameritrade Inc., an Omaha, Neb.-based online brokerage, voices similar concerns. "If you think about what most of the active traders do, they've got multiple windows open, and they're really filtering a lot more information than you could ever put on a cell phone display," he observes.

Still, there are signs that the market for handheld wireless trading systems may be about to heat up. One of the biggest indications comes from Fidelity- the industry's third largest online trading player-which plans to begin offering handheld wireless trading services to its customers by early next year.

Gotta Have It

"Anyone who is catering to a trading population is going to have to have this capability, and I think it's coming down the tracks very quickly," declares Stephen J. Killeen, Fidelity senior vice president. The ability for customers to trade using wireless handhelds "is one of the next generation of deliverables that brokerages will have to have as part of their offerings," Killeen says.

Fidelity plans called for a launch of a wireless information-only service by late October or early this month, by which its most active investors could use paging devices from a variety of manufacturers to receive quotes, account balances, order executions and alerts. And by next year's first quarter, Fidelity is expected to begin offering those same customers the ability to place trades using two-way pagers. The addition of trading for Fidelity customers using other handheld device types, including organizers, handheld PCs and smart cellular phones, is planned for "some time in 1999," Killeen says.

While Killeen says Fidelity developed its handheld wireless trading and market data delivery technology entirely in house, a number of third party vendors are springing up to offer the service on a turnkey basis to online brokerages and clearing houses.

w-Trade Technologies was the first to market with its w-Trade Wireless Internet Trading System, which was introduced last February. The system allow investors to obtain real-time quotes, receive broker-generated and investor-specified alerts of market changes and price movements, manage their portfolios, and place trades using any of a variety of wireless handheld devices. Data can be delivered using any of several wireless network technologies, including cellular digital packet data, or CDPD, which provides coverage for about 80% of the United States.

Besides InvesTrade, at least one other small brokerage-The Wall Street Discount Corp., New York-has announced that it is testing the w-Trade system, with plans to roll out the technology this fall. And Donna R. Oliva, w-Trade's chief executive officer, says that "a handful" of other brokerages have already signed contracts to use the service. She expects that several will announce the service before yearend.

Here They Come

Other market players include GTE Corp.'s Information Systems Division, Chantilly, Va., which in late September unveiled a system called the GTE Wireless Trader that it is marketing to brokerage firms and clearing houses. And last month, the Reality Online Inc. subsidiary of Reuters America Inc. teamed with Aether Technologies International LLC, an Owings Mill, Md., vendor, to introduce a handheld device wireless trading capability. Reality Online, based in Norristown, Pa., provides Web hosting and back-office connectivity for more than 35 online brokerages. The company plans to offer the handheld wireless trading capability as an additional option for its brokerage clients to provide to their retail customers.

Given the explosive growth in online trading and the rapid proliferation of cellular phones and other handhelds, some industry watchers see wireless Internet trading and market data delivery services as the next logical step for the online brokerage industry.

Investors will buy into the technology because of its convenience, predicts Sylvia M. Chou, an analyst with The Tower Group, Newton, Mass. "With this technology, you're not tied down to a laptop or to your home office PC. You can be anywhere and get real-time information and act on that information as it comes in. And with the increased sophistication of individual investors, they're going to want to have the tools and the information to make those trades," Chou says.

In a report released last July, titled "Wireless Market Data and Trading: A Step Beyond the Internet," Chou predicts that industry revenues for wireless delivery of market data alone, without an associated wireless trading capability, will grow from around \$ 1.25 million this year to about \$ 40 million in 2002. Given the newness of the handheld wireless trading capability, she declines to project its revenue impact on the market, but says it could be substantial.

Not surprisingly, wireless trading system vendors are among the most optimistic about the technology. And some project a rapid brokerage adoption curve. "Once a couple of the big guys come out with it later this year and early next year, I think you'll see them all start to offer it," says David S. Oros, Aether president and chief executive officer. "I'd say you'll probably see 50% of the brokerages offering wireless trading by this time next year, and you'll see 100% 18 months from now," Oros declares. "I think it's just going to be a necessary competitive tool that everybody's got to offer."

Others, including Bryan A. Burdick, senior vice president, marketing, at Reality Online, are more cautious. "We believe it will be two years at the maximum before wireless trading becomes very prominent," Burdick says. But at the same time, he predicts more conservatively that perhaps 10% to 20% of all online brokerages may be offering the service in that time frame.

For brokerages, the potential advantages of offering wireless handheld trading are several. In the short term, until the service becomes more common, the technology will be a valuable way for online brokerages to differentiate themselves and attract new accounts, proponents say. What's more, when investors are given the capability to trade at any time from almost any place, they are likely to trade more often, some believe, resulting in more profits for the brokerage.

Addiction

"I have a feeling that when you put this in the hands of someone who loves the market and can't stay away from it, that if they normally do five trades a day, they're going to do 10 trades a day with this service," says one online brokerage executive who asks not to be named.

The cost to brokerages to get started with a handheld wireless trading capability can be modest, vendors say.

"We don't have a fixed price for every broker," says Yogesh Khanna, director of financial services for the GTE Information Systems Division. GTE is already working with several brokerage customers, some of whom may launch the GTE Wireless Trader system before yearend, he says. And the division has already negotiated a variety of pricing schemes.

"In some cases, we're willing to give the system away for nothing, as long as there's some type of revenue sharing back to GTE," Khanna notes. That might mean a fee paid for each wireless trade made using the system, for instance. In other cases, brokerages may want to acquire the GTE software flat out and pay no ongoing fees. In that case, the price might range from \$ 100,000 to \$ 150,000, depending the system configuration, Khanna says.

w-Trade takes a similar pricing approach. The w-Trade system can be either installed on a brokerage customer's system, or w-Trade will host the service for a brokerage at its own New York data center, says Oliva. "Brokerages can get up and running for as little as \$ 2,500," she says, for a set-up that is hosted by w-Trade and is subject to ongoing fees based on the number of investors using the system. Alternatively, brokerage customers can purchase a one-time license and pay no per-user fees, Oliva says. She declines to provide numbers.

Most agree that wireless trading and financial information services should have strong appeal to an upscale class of mobile, "emerging affluent" investors of the type that brokerages want to attract. But some say that handheld hardware costs and fees associated with the services could hinder acceptance by more mainstream consumers. At the same time though, many expect to see downward pricing pressure as more brokerages launch the technology. In fact, some are already talking about pricing promotions and handheld device giveaways as a way to attract new customers.

Monthly Fees

At InvesTrade, users of smart cellular phones pay about \$ 60 per month to use its wireless trading service, says Bokios. That includes a \$ 29.99 fee to InvesTrade for the trading service and an additional \$ 29.99 wireless network fee paid to AT&T Wireless or another carrier. For devices such as the PalmPilot, which support a stock charting capability not available on the cell phones, the monthly trading service fee is \$ 54.95.

InvesTrade leaves it up to customers to obtain their own PalmPilots—priced at \$ 299 or \$ 399 each, depending on model—as well as a separate \$ 399 wireless modem needed to use the wireless trading service, Bokios says. But for consumers who want to use either of two models of \$ 99 smart cellular phones, which come with the modem built in, "we're having a special through the end of the year where we're giving the smart phone away free to anybody who opens an account with at least \$ 10,000," Bokios says.

Who Pays?

At Reality Online, pricing for the planned wireless trading service has not yet been set, but is expected to fall at around \$ 100 per month per user. "That's the price we'll charge to the brokerages. We won't care who pays it," says Burdick. While some brokerages expect to pass the cost along to their customers, others are considering plans under which the brokerage would pick up all or part of the cost, he indicates.

For online brokerages that already use Reality Online's hosting services, the addition of wireless trading services should be "almost a no-brainer," Burdick says. Current brokerage customers have already spent between \$ 150,000 and \$ 300,000 to connect their back office systems to Reality Online, he notes. The wireless trading capability can be added for an incremental amount ranging from \$ 20,000 to \$ 100,000, Burdick says, "and we can have them up and running in a couple of months."

Burdick expects the first Reality Online brokerage customers to roll out wireless trading during next year's first quarter. And as the idea catches on, the addition of Aether's wireless trading capability will also help Reality Online attract additional brokerage customers for its Web hosting services, he figures.

Despite an apparent groundswell of interest in wireless trading technology, there are still hurdles to be overcome before the technology hits the Internet mainstream, many believe.

One involves the wireless data infrastructure. At Aether, Oros notes that his company last February partnered with Reuters America to launch a wireless information-only service called Reuters MarketClip. The service delivers real-time quotes, option chains, charts, news headlines, market summaries and alerts to users of PalmPilots and devices such as Hewlett-Packard Co.'s HP 360LX that run Microsoft Corp.'s Windows CE operating system.

The MarketClip service, priced to consumers at \$ 115 per month, currently has more than 800 users, says Oros. "And one of the limitations we've seen is that wireless data coverage is still an issue," he concedes. In some cases, users in office buildings may be forced to move close to windows to receive the service, for example, or they may have coverage at work but not at home, Oros says. The two most significant U.S. wireless data network systems—CDPD and a system called RAM Mobitex, operated by Bell South Wireless—together cover most major cities, sources say. But according to Oros, neither can yet match the level of coverage as that provided by cellular voice systems.

Too Small?

The coverage issue is one that comes up in discussions with online brokerage executives. But among those who have not yet embraced wireless handheld technology for trading, perhaps the most frequently raised question involves the small size of the device displays.

"Somewhere down the road, this technology is probably going to benefit the day trader, but I just don't know whether or not there's enough information on the screen," comments Joseph J. Fox, chairman and president of Web Street Securities, a Northbrook, Ill. online brokerage whose client base includes a large percentage of active traders. Fox says he has discussed wireless handheld device trading technology with representatives of w-Trade and one other vendor. "When I saw a demonstration, it wasn't as satisfying as I expected it to be," he observes.

Those rolling out the service are taking different approaches to the display size issue. The Reality Online/Aether service will initially support only PalmPilots and Windows CE-based devices, and will not support smart phones, says Oros. Smart phone displays typically measure about 151/48 by 71/48 inches, he says. And when Aether two years ago launched a wireless market data service for use on smart cellular phones, "we quickly learned that the screen size was too small," Oros explains. By contrast, the PalmPilot display, which contains a 231/48 by 231/48-inch active area, is "more than adequate to meet the needs that we're seeing out there," he says. Oros says Aether will offer a lower-priced service for use with smart cell phones by around mid-1999.

Others, however, including GTE and w-Trade, will support various handheld devices immediately, including smart phones. At Wall Street Discount, in fact, Alan Lederfeind, chief executive officer, says that his firm plans initially to offer its w-Trade-based wireless trading service only for use on smart phones. "Like anything else in the world, you have to get used to it," Lederfeind says of the smart phone's small display size. "But if you just put your thumb on the scroll button, it can scroll right down to what you want, and it's very fast. I don't consider that a downside at all."

At GTE, Khanna says the question of handheld device display size all comes down to the type of client being served. "Sophisticated traders who need a lot of graphics are not a target for smart phones," he says. For this group, the PalmPilot and other larger display devices are likely to be "more satisfying," he says. These devices are capable of receiving and displaying stock charts and other graphics written in HDML, or Handheld Device Markup Language, a language developed for the wireless data market.

Smart Swap

But Khanna is quick to add that smart phones should be ideal for investors who don't rely on a lot of analytics and graphics, but make trading decisions based on real-time quotes and market alerts. Many in this group are "probably already carrying a phone today," he says, "and by just swapping their standard cellular phone with a smart phone for an incremental cost, they'll have basically a wireless data terminal at their fingertips."

The market, of course, will ultimately decide how broadly and how quickly trading through wireless handheld devices takes off. But the technology is one that looks certain to soon begin attracting more attention from brokerage executives.

"If ever there was an application for the frenetic trader, it's cell phone trading, and it might very well be that you'll find a segment of the population that wants to trade from the phone," notes William L. Burnham, vice president and senior research analyst at Credit Suisse First Boston Corp., in San Francisco. "I don't think you'll go out of business if you don't offer it," Burnham says. "But it is an interesting way to distinguish yourself from the crowd, and that's what a lot of brokerages are trying to do."

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The cozy marketplace enjoyed by cellular carriers is about to end. A chill wind is brewing for wireless providers.

A Wireless Ice Age is coming, and it is being triggered by four fundamental forces. First, new inhabitants - the recipients of PCS licenses - are coming into the wireless world. The cozy duopoly of wireless' "Golden Age" will come to an end, and as the number of wireless service providers grows, so will the intensity for competition.

Second, food - i.e., revenue - will become relatively scarce. While overall subscriber levels and revenues will increase, this will not be adequate to support population growth. The combination of price competition and pricing practices will cause the average revenue per subscriber to decline and, in time, subscriber and revenue growth will diminish as the market approaches saturation.

Third, survival skills will become critical. Marketing skills are needed to secure the disproportionate market share needed to persevere, and operations skills are required to contain costs, to contend with the increased complexity of the environment and to meet requirements for delivering service in a "buyer's market," that is characterized by intense competition.

Fourth, the stores of food - in the form of capital - available to those within the wireless world will shrink. The key question is when capital availability will diminish. It may not happen early enough to prevent the emergence of a significant number of competitors, but when it does finally occur, it could induce competitors to take drastic actions which, ironically, will only make competition more intense.

These changes will have extremely serious consequences. Unlike the Golden Age, in which survivability and value creation were not in question, a number of the inhabitants of the Wireless Ice Age will starve to death.

Number and Nature of Competitors

The way the industry was structured during wireless' Golden Age reduced the intensity of competition. The duopoly and the nature of the inhabitants combined to constrain or moderate competition, particularly in relation to airtime pricing. But as duopoly disappears and concentration dissipates, a number of competitive drivers that were suppressed in the Golden Age will emerge (see Table 1).

The new entrants will come from two sources: Most will emerge from the PCS auctions, and they will be supplemented by ESMRS (Enhanced Specialized Mobile Radio Service) providers (although not likely more than one in a market). The PCS auctions could theoretically provide as many as six new operators in each territory, but it seems more likely that between three and five independent PCS operators will join the two cellular carriers in each service territory. The total number of facilities-based competitors could rise from two to between four and seven (two cellular, four PCS, one ESMRS), a total that does not include resellers.

The character of the participants will also change. During the Golden Age, the competitive practices of the cellular carriers were largely benign. The duopoly was content to serve the plentiful supply of mobile customers, and cellular

technology did not lend itself to being a substitute for wired telephony. In contrast, the agendas of virtually all of the new PCS licensees - even the former duopolists - is much more aggressive, for reasons summarized in Table 2.

Every new entrant faces two incumbents that have all of the market share. The new entrants TABULAR DATA FOR TABLE 1 OMITTED obviously will try to find customers who are new to mobile telephony, but if that search doesn't yield enough customers to meet their expectations, the PCS operators will be forced to raid the incumbents' customer base.

TABLE 2

Reasons for New Competitive Aggressiveness

- * Need to attack incumbents
- * Inevitable airtime price competition
- * Landline substitution strategy
- * Strategies of IXC's
- * Effect of convergence
- * The possibility of an unpredictable competitor
- * The possibility of a disappointed competitor
- * The effect of resale
- * Competition from narrowband PCS

Indeed, the mere fact that new market entrants exist will increase competitive intensity. Airtime price competition, which was moderate during the Golden Age, will become a key element of each new competitor's strategy.

Another competitive driver comes from the potential to use high-capacity, digital PCS platforms for both basic landline telephone service and mobile service. Since wireless has always commanded a significant premium over basic local telephone service, any attempt at landline substitution must involve very aggressive pricing - orders of magnitude less expensive, for both access pricing and included minutes, than current cellular telephone rates. This would also have a significant spillover effect on general mobile service pricing.

The IXC's with PCS licenses, and AT&T in particular, see wireless as a way of obtaining access to local phone users without having to pay access charges to the LEC's for the origination and termination of long distance calls. What the IXC's will do with any such savings is unclear, but it could permit them to offer more aggressive airtime pricing than would otherwise be the case.

Note that the issues surrounding wireless pricing are representative of a larger, industry-wide problem. As technologies converge and regulatory barriers are removed, previously distinct revenue streams (telephony, wireless telephony, cable television and long distance) become increasingly subject to competition. For the major operators, wireless telephony is just another service that can capture customers and that can be combined with other offerings to present a comprehensive array of services.

Since at least some PCS licensees will neither be linked nor have links to experienced wireless providers, there could be wide-ranging experimentation in marketing approaches. If a competitor's initial marketing strategy doesn't succeed, it could trigger still more experimentation as the service provider tries to find the formula that will yield market share and profits.

However, opportunities for disappointment will be widely available in the coming Ice Age, and some wireless providers, like Nextel, have already paid a price in terms of share values. But Nextel is not without resources, and an aggressive program to reassert itself could trigger the commencement of price competition.

Facilities-based carriers will not be the only source of increased competition. Potential resellers (e.g., MCI and Time-Warner) are emerging with plans to bundle wireless with other service offerings. These efforts will intensify competition in wireless by adding already competitive services (e.g., long distance) and brand names.

Facilities-based carriers from other segments of the wireless industry could also contribute to the competitive intensity of wireless telephony. In the Golden Age, the cellular telephone and paging industries coexisted peacefully. Paging,

as a one-way signaling technology, had a growing market, but it didn't exhibit much substitution capability in relation to two-way cellular telephony service.

TABLE 3 Subscriber and Revenue Growth Rates

During the Year	Subscriber Growth Rate	Industry Revenue Growth Rate
1993 (Actual)	43%	37%
1997 (Estimated)	29%	18%
2001 (Estimated)	10%	0%

Sources: EDS Research

But now the FCC has auctioned the narrow-band PCS spectrum to provide for various forms of advanced paging, including two-way paging, which could be in the form of voice or data. Voice messaging with response may become a low-end competitor to mobile telephony, including broadband PCS, and, if priced aggressively, could either capture a share of consumer demand for mobile communications or force providers of mobile telephony to increased levels of competitiveness.

Growth of Overall Market Demand

In the Golden Age of cellular telephony, subscriber growth was spectacular relative to the number of players. Indeed, vigorous competition was unnecessary because a disproportionate share of the market was not essential to survival.

The arrival of an Ice Age is unavoidable, because even under the most optimistic projections, subscriber growth will slow down. The demand curve (plotting subscribers against time) will likely take shape of the standard S-curve for adoption of technological products and services ILLUSTRATION FOR FIGURE 1 OMITTED!. The projection of 120 million mobile telephony subscribers in the year 2005 is consistent with the recent estimate of the Personal Communications Industry Association.

From 1999 onward, however, the absolute subscriber growth rate will decline. Since market growth will no longer be a source of increased revenue, the only other remaining source is a competitor's subscribers.

Note that in Figure 1, the cusp of the curve occurs around 2002, and then the rate of subscriber growth falls off dramatically. As the market approaches saturation, providers will become increasingly hard-pressed to replace customers who churn out of the system.

Churn has been a persistent issue for the cellular telephone industry. The churn rate runs about 2.5 percent per month, which means operators must replace the equivalent of half of their entire customer base every 20 months just to maintain their positions. Churn will become critical in the Ice Age as the market becomes saturated, and it will contribute to the cycle of competitive intensity - shrinkage in a competitor's customer base caused by unreplaced customers is likely to stimulate the competitor to lower its prices.

Moreover, industry growth is slowing much quicker than it appears in Figure 1. Table 3 translates the penetration curve into a year-on-year subscriber growth rate, and shows a constant 10 percent per year nominal decline in average revenue per subscriber from 1997 through 2001.

Differing Cost Structures

During the Golden Age, the cellular competitors within the duopoly had substantially similar cost structures in terms of both fixed and marginal costs. Cellular telephone systems were essentially similar in design and implementation, and, since the importance of operational effectiveness was minimized, fixed costs and operating costs did not diverge materially.

In the Ice Age, cost variability, both fixed and marginal, will be much greater, and this has important implications: Differences in cost structure affect pricing flexibility. The variability in pricing structures is the result of a several factors. First, in the absence of a standard imposed by the FCC, PCS licensees can adopt different technologies, which have dissimilar cost structures not only from each other, but also from those of cellular telephone operators.

Second, the role of resellers will be much more significant than in wireless' Golden Age, and they have very different cost structures than facilities-based carders. Third, while partnerships during cellular's Golden Age arose generally as a result of settlements between contenders of licenses, the recent partnerships formed for PCS are specifically aimed at creating competitive advantages (e.g., access to customers, access to infrastructure). The partnerships will magnify differences in the cost structure of the competitors.

Fourth, some providers will seek to bundle mobile telephony with other services (wired telephony, entertainment, long distance service, and, possibly, even electric power). This will create marketing costs very different from unbundled services, and the pricing of bundled services may be very different from the pricing of the disaggregated components.

Providers of Capital

In the Golden Age of cellular telephony, the providers of capital could afford to be patient - values were increasing. Certainly, some will continue to show considerable patience because they have adopted a very-long-term view of market development. For example, the corporate parents of the major wireless operators have done this, especially when the wireless agenda is part of a broader integrated strategy (e.g., AT&T, Sprint and its partners in Wireless Co.).

However, most providers of capital will show considerable impatience, because their expectations will be unfulfilled. Some will have invested based on the lessons of the Golden Age, but those lessons will prove short-lived and inapplicable to the Ice Age.

As a result, the financial markets will behave less kindly toward wireless providers than they have in years past. Vendor and venture capital may well be available at the early stages of the new era, but the supply of capital will soon dwindle for carders that do not demonstrate the operational effectiveness to achieve expected results.

If capital suppliers believed that a Wireless Ice Age was coming, they would withhold their capital, and the result would be the emergence of fewer competitors and, ironically, a more moderate Ice Age climate. However, faith that the history of the Golden Age will repeat itself makes an early withholding of capital less likely. The carders that disappoint their suppliers of capital will be condemned to extinction.

Food Supply

Although the impulse toward price competition will affect some carders more than others, certain drivers (e.g., ultimate market saturation and churn) will impel all carders toward price competition either in response to their own disappointment or in reaction to the responses of others. Isolation from the effects of price competition is not possible.

Fundamental to the Ice Age is the inadequacy of revenue to support all of the population. The Average Revenue Per Subscriber (ARPS) has been decreasing at 8 percent per year, measured in nominal terms, since 1987. These price declines, however, have been primarily related to lower-usage subscribers coming onto the network, as opposed to price competition between the cellular carriers. Indeed, the CTIA recently estimated that ARPS for new subscribers have been averaging about \$ 40 per month, even though the overall customer base has been averaging \$ 58.65 per month.

Aggressive price competition will begin in late 1996 or early 1997 as PCS providers turn on their networks. The ultimate price floor is very difficult to estimate. However, since ARPS is currently decreasing at the rate of 8 percent per year, decreases of 10 percent per year from 1997 onward would seem conservative. On this basis, ARPS (net of long distance revenues) would decrease to \$ 30-\$ 35 per month by 2000 and continue decreasing to \$ 20 per month by 2005.

Effect of Revenue Inadequacy on New PCS Operators

In order to explore the conditions under which revenue inadequacy will occur, a financial model was constructed to simulate the future mobile telephone industry. The primary assumptions used by the model are as follows:

*** The growth of PCS services will follow a second-generation adoption model. The adoption curve is calculated using standard Bass diffusion techniques.**

* The overall wireless telephony market will reach 40 percent population penetration by 2006, of which PCS will account for 15 percent. Existing cellular telephony and ESMRS providers comprise the remaining 25 percent.

* License costs are based on the average actual bids from the recent MTA license auctions.

* Valuation is based on discounted cash flow methodology, using a 12.9 percent after-tax weighted average cost of capital for the discount rate and a terminal multiple of 12 times earnings before interest, taxes, depreciation, and amortization (EBITDA).

For each MTA, the model was run at five different ARPS levels, ranging from \$ 45 per month down to \$ 25 per month. Market shares are presented in terms of the share of the PCS market only, not in terms of the overall wireless voice market (i.e., PCS, cellular, and ESMRS). The definition of "survival" is obtaining a net present value greater than zero. The data are summarized in Table 4.

TABLE 4 Required Market Share for Survival as a Function of ARPS

ARPS	Large Markets	Medium Markets	Small Markets
\$ 45	17% to 35%	16% to 31%	33% to 83%
\$ 40	22% to 47%	22% to 42%	42% to 100%
\$ 35	31% to 48%	34% to 66%	62% to 100%+
\$ 30	67% to 100%+	80% to 100%+	100%+
\$ 25	100%+	100%+	100%+

Sources: EDS Research

The slightly higher market share required for survival in large markets (relative to the share required for medium-sized markets) is due to the unusually high bidding amounts, and thus license costs, experienced during the PCS auctions. Three important inferences arise from this analysis:

* First, no PCS provider may be able to survive the Ice Age if ARPS drops to \$ 25 per month.

* Second, companies in smaller markets will have a much more difficult time surviving. The minimum market share required for survival in small markets appears to be roughly double that required in medium or large markets, simply because the population of those small markets is lower than needed to support full network build-out (e.g., 66 percent population coverage).

* Third, reasonably aggressive market shares (e.g., 25 to 40 percent) appear adequate for survival only in medium and large markets and only when ARPS exceed \$ 40 per month. The question remains, however, whether ARPS in excess of \$ 40 per month is sustainable. With the majority of new customers currently averaging about \$ 40 per month in an environment of no price competition, it seems unlikely that ARPS will stay above \$ 40 per month.

If ARPS drops to \$ 35, a very reasonable assumption given the likelihood of price wars, the 30 to 60 percent market share required for survival in the large markets means that at least some of the three to five new facilities-based providers won't survive. When some of these companies begin to realize that they face extinction, they will begin to get desperate - prices will come down in an attempt to gain market share. This may be effective in attracting customers, but then the larger players may in turn reduce their prices in order to close the gap. This downward price spiral will merely serve to increase the required market share for survival.

It is hard to believe that the PCS bidders are not aware of the implications of the data. Their presence at the auctions and their willingness to bid such significant sums must relate to their optimism regarding their ability to obtain disproportionate market shares. Clearly, that optimism cannot be realistic for all potential bidders.

Effect on Existing Cellular Carriers

The challenges of the wireless ice age. Wireless Computing Business Commu

Cellular telephony incumbents can depend on their existing networks and customer bases to enjoy a headstart over their PCS competitors. Indeed, many industry analysts project that cellular incumbents will have a combined 60 percent market share of the overall wireless voice market in the year 2005. However, these incumbents also will experience Ice Age conditions of declining ARPS and eventual market saturation.

Since the industry is still relatively young in terms of the development of demand, over the next few years cellular providers will continue to grow very fast, even with PCS competition. Nothing, however, will insulate the cellular incumbents from the effects of the intense competition that will be expressed in decreasing prices and increasing rates of customer churn.

Last Word on the Challenges of the Ice Age

In the face of revenue inadequacy and intense competition, operational effectiveness in the Ice Age will be a critical success factor to a degree unprecedented in the Golden Age. Effectiveness in marketing and in cost management not only will be conditions to survival, they also will be a source of increased competitive intensity.

Effective marketing by one competitor will, in light of revenue inadequacy, place significant pressure on other competitors. Their reaction will likely come in the form of price competition. Effectiveness in cost management provides scope for price flexibility which, for the same reason, will add to the competitive pressures.

Each of the forces that has shaped the wireless world is about to change, and each change inescapably points to a far more hostile environment than the wireless world has ever known. There will be an extraordinary increase in the intensity of competition for the supply of revenue/sustenance. The food supply will often be inadequate to feed the growing population, a situation exacerbated by declining stores of food.

As a result, competitive skills will become increasingly important for survival. Welcome to the Wireless Ice Age.

This article is an excerpt and adaptation of Chapter 4, "The Challenges of the Ice Age," from a monograph *An Ice Age is Coming to the Wireless World - A Perspective on the Future of Mobile Telephony in the United States*, published by A.T. Kearney, an EDS company (formerly EDS Management Consulting Services) as part of the Communications and Electronics Industries Consulting 1995 Thought Leadership Series. Reprinted by BCR with permission. For more information on this article or the monograph contact Ms. Amy Kozlowski at 703/908-3149.

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